Office of Head Start - Measurement Math Webcast

(links for viewing and download at end of transcript)

[Music]

Amanda Bryans: Welcome to the fourth webcast in our six-part series on mathematics and the young child. My name is Amanda Bryans, and I'm the director of the Educational Development and Partnerships Division at the Office of Head Start. Thank you for joining us for today's discussion about measurement. Hopefully, you have seen the first three webcasts in this series on early mathematics.

If not, you can watch each one at any time by simply visiting the Early Childhood Learning and Knowledge Center, affectionately known as the ECKLC website. If you have joined us before, you know this webcast is divided into three parts. Just as in previous webcasts, during the final part you will be given the opportunity to ask questions.

There are two ways to do this. Throughout the webcast, you may type a question into the "ask a question" form on the browser, or you can fax us your questions. Our fax number is also posted on your browser. We strongly encourage you to email or fax us your questions about today's content.

You can also download a copy of our Viewer's Guide by clicking "download worksheet" located at the lower portion of the screen. After each webcast, we provide a list of resources for further study, and we invite your feedback on this series. As all of you are aware, on December 12, 2007, President Bush signed into law the Head Start for School Readiness Act, which reauthorizes the Head Start legislation for the first time since 1998.

The strong bipartisan support for the bill confirms the commitment of Congress and the country to Head Start, and the nearly one million children and families we serve. The new legislation requires that we review, and when appropriate, revise the Head Start Program Performance Standards. Although this means some of the Standards may change, the intent of the Standards, which reflects evidenced-based best practices, will remain the same.

Our program has a long history of providing high-quality early child development services to preschool children, and our commitment to maintaining that tradition is evident. Today we have worked to help our teachers become more intentional about what they are doing in the areas of early language and literacy development, and our work is proving effective.

Still, the expectation remains clear and the aim is high. We must ensure that all Head Start children continue to make progress in mathematics, as well as literacy, and other school readiness skills. This series on mathematics and the young child is designed to help you achieve part of that goal by providing you with the knowledge, and the most effective classroom strategies needed to help develop children's understanding of early math concepts.

As Dr. Copley has demonstrated in this series, math is everywhere in the life of a young child. Our job is to connect them to it. Drawing attention to the math concepts that appear in the everyday experiences of young children, with intention, helps them to make sense of the world around them.

These concepts also help to build a solid foundation for success in school later on. Before I turn the webcast over to Dr. Copley, I would like to share a short story. I have a daughter who is now two-and-a-half years old, and I just wanted to tell you how much my attention to her early math development has been heightened by being able to watch the webcast series.

Many of the activities that she engages in related to math I probably would have noticed and enjoyed previously, but I wouldn't have necessarily really recognized them as being related to math. She was recently sitting in the bathtub and she had a small cup and big cup, and she spent a long, long time pouring the water from the big cup into the small

cup, and watching the water overflow, and she did this many, many, many times. And I kind of commented on it, but I didn't try to steer her any way.

And then after a while, she reversed and started pouring from the small cup into the larger cup and having you know, refill the smaller cup a lot of times. And it just occurred to me how much that was her learning about math, and some ideas about conservation and less is more -- less and more -- and her desire to do it over and over again was because she was learning and trying to really understand the concepts. And she still doesn't totally have it, but we may have another prolonged bath again tonight.

But I think the important thing for me is that I feel really good about my enhanced ability to recognize what she is doing with regards to math learning at her early age. And now, on to even more information about math. Dr. Juanita Copley.

Dr. Juanita Copley: Thanks, Amanda. It is always a joy to hear how the webcasts are affecting teachers and other people who see the webcast. Thank you. Measurement is a topic of natural interest to even very young children. Do you remember a story I told about "big" during the first webcast? I was walking a young child out to the bus stop when he asked the familiar question, "Are you bigger than my teacher?" When I responded, "Do you mean taller?", he expressed his meaning by responding, "No, more number."

Clearly, he meant age, not size. The question of who is bigger is a familiar one for many young children. In their eyes, it is an important question. Mathematically, it is a measuring question that I love to mathematize! This illustration was drawn by a four-year-old who showed it to me and said, "I'm taller." As you can see, his head is drawn taller than mine, even though he is suspended in air. So from his perspective he is taller! For this child, tall is the same as, "how high up it goes!"

Another common measuring question is, "How old are you?" This 3-year-old responded by showing her fingers. She doesn't really know that her "three" stands for three years, but nonetheless, she knows that three is the answer! "My tower is bigger than your tower," is a common statement you might hear in any block center. The general term, "bigger" could mean more blocks, taller in height, more spread out, or even wider. This young child is sorting his bottles and deciding which one will hold the most of his favorite liquid!

He will use perceptual clues to compare and decide on the container that looks like it is the biggest! These children are drawing around their friend to see how big he is. They will then try to match his shape with theirs as they lie down on his sidewalk outline. As always, their question is, "Who is the biggest?" Remember this picture from the first webcast? Wyatt is just sure that he is "big enough for papa's shoes!"

Comparing the size of shadows is a wonderful measurement activity, especially when you can make the shape sorter -- shorter or longer just by moving! Their questions are, "Which shadow is longer?" and, "How can I make my shadow longer?" This child's play provides a mathematizing opportunity! How much a container holds is a capacity measurement, and one that children care about, especially if they can pour with just a little bit of spillage!

These children are demonstrating another capacity measurement question -- one that is especially important during clean-up time! "Will all of these shapes fit in this box? Can we get them all in there?" So, why measurement? First, it is a natural part of children's interest. As you have seen from just these few examples, children want to answer questions that require measurement skills. Second, measurement is especially connected to number and geometry concepts.

I know that this will be evident as we progress through the webcast, and hear and see children use numbers and shapes to talk about their measurements. Third, the study of measurement is recommended by national organizations, state standards, and is included in the Head Start Child Outcomes Framework. To emphasize that last point, let's look at the graph published by the National Council Teachers of Mathematics that shows areas of emphases. The blue section represents measurement.

You can see that it is quite large in prekindergarten and throughout the primary grades, and that it tapers off as children

learn other upper grade math skills. Yes, measurement is important in the early years, and it provides a foundation for students in middle and high school. If you've joined us before, you know that today's webcast is divided into three parts -- the same parts as the first webcasts, and the same format as all future webcasts.

Part one will answer the "what" question, "What do children need to know to understand measurement?" Part two will answer the "how" question, "How do children learn measurement?" And, finally, part three we will answer your questions during "What else?" What is measurement? Measurement is defined as assigning a number to a continuous quantity. For example, thirty inches is assigned to describe the circumference of a ball. Three feet is assigned to a child's height.

Twelve pounds might be assigned to describe how much a basket weighs, and twenty-six cubic centimeters could be assigned to the capacity of a container. For young children, many experiences are necessary if they are to develop the concepts they need to understand measurement. Research indicates that children as young as two know some measurement ideas.

For example, they know that attributes such as weight and length exist. They may describe something that is heavy as "big" or demonstrate that it is heavy by their actions. Or, they may talk about something that is long as simply saying it's "stretching far" or "bigger than Daddy." When a child says, "My dog is bigger than your dog", it could mean that the dog is taller, heavier, or fatter. Children evaluate and compare things based on these characteristics.

Regardless of their meaning, children are comparing based on a size attribute. Children also know that if they have some material and they get more, they now have more than they did before. "More" is generally a word they understand from an early age, and they will continue to use the word "more" to describe new measurement experiences. Fourth, and probably most importantly, children use perceptual clues to compare two objects or amounts.

In other words, they use their judgment based on their observation, not their measurement, to decide which object holds more, is longer, heavier, or taller than another one. Remember the picture we showed at the beginning of the webcast -- the one the child drew to show he was taller than me? That child used perceptual clues to compare his height to mine. In other words, from his perspective, he was taller than me because he looked at the top of our heads.

You will see many other examples of children using perceptual clues to measure as we go through this webcast and, of course, as you observe young children. As we begin to answer the question, "What is measurement?", we must first discuss three important concepts that provide the basis for measuring: conservation, transitivity, and unit.

Each of these concepts develops over time, and a child's current level of understanding helps inform how we teach measurement. First, let's talk about conservation. One possible meaning of conservation is that a quantity or amount does not change if it is moved, reshaped, or divided into parts.

A familiar way to illustrate this idea is to give children the clay task. For example, I can give them a ball of clay. It can be wrapped, it can be shaped just this way, and I could say, "Please look at this ball carefully, and watch what I'm going to do." I could then take the ball and make it simply be a long, skinny worm, and I could constantly move is back and forth until it became a very, very different shape, and I could say, "Look at this worm of clay. Can you tell me what just happened?"

Many children that I had done this experiment with say, "Oh, it's bigger." And I say, "What do you mean by bigger?" "Oh, look, it's bigger." And they may do this or they may say it is simply longer. When I put it back together again into the ball, they may say, "Oh, its back little again", or they may give another type of explanation. A child who demonstrates conservation will be able to say, "It doesn't matter what it looks like, you didn't get rid of any clay or add any to it. You have the same amount."

In most cases the child who does not have conservation will use perceptual clues and decide that the long skinny clay is more than the ball of clay because it looks like more. This concept of conservation can be demonstrated in many other ways as well. In the following video clip, you will see a volume task completed by two children. Let's watch as Alvaro and Kira decide which container will hold the most liquid.

[Video begins] Dr. Copley: We're going to do something fun, yeah, we are. I have two containers. You see the two? This one, what words would you use to describe it? Child: High. Dr. Copley: High, it's high. Child: Down.

Dr. Copley: This one is down. Good. Alvaro: Fat. Dr. Copley: That one is fat. Is this one fat? Alvaro: No, it's skinny.

Dr. Copley: That one is skinny. Very good. Now, what I'm going to do, I'm going to ask you to tell me which one you think will hold the most water. Alvaro: That one. Kira: This one, this one.

Dr. Copley: Okay, so you think this one here and Alvaro, you think this one? Alvaro: Uh-huh. Dr. Copley: Ok. Well let's see. What I'm going to do is take the one you think holds the most and fill it all the way to the top with water. So let's see. Should I try yours first? Okay, all right, she think this one goes all the way to the top.

Alvaro: And mine, too. Dr. Copley: So what we are going to try is this. I'm going to -- then we will try yours. I'm gonna fill this all the way to the top and I'm gonna put it over here so I don't spill anything going down. Let's see. Let me see, I want to get it all the way to the top. I put green food coloring so we can see it. We wouldn't eat this, we wouldn't eat this, or drink this. This would just be --

Alvaro: Good? Dr. Copley: All right. Now you think this holds the most? Kira: Yes. Dr. Copley: You don't think so. If she's right, and I pour it in here, it will spill out, right? Alvaro: Yeah.

Dr. Copley: You ready to see? Notice I brought this, so let's see. Are you ready to see? This is so cool, ok. Alvaro: No! Dr. Copley: Do you think you are right, that this one is bigger? Alvaro: Uh-huh.

Dr. Copley: Why? This one looked taller, didn't it? Alvaro: Yeah. Dr. Copley: Should we try yours now? Should we fill this one to the top and see if it spills? Okay, let's do that. I will leave it in there and then I will fill this one all the way to the top. Here we go. Oh, you guys can do this at the water table, too. I will let you use this when you get back in the room sometime.

Oh, oh, that's a lot. Dr. Copley: Oh man, that's a lot. Now, I'm probably spill some just by pouring, but let's see if we can get... If this one holds the most it will spill out when we do it. Ready? Alvaro: Oh, yes, it spilled! It spilled.

Dr. Copley: Oh, it spilled, so you were right. That one -- this one held the most. Did you see how much water spilled on that one? Isn't that funny how that looks? Do you want to try another one? Children: Yeah!

Dr. Copley: Okay, let's try another one. First of all let's pour this back in here and you can see why I am using this thing, aren't you. We will just pour it back in here.

Alvaro: I told you I was right. Dr. Copley: You knew that, how did you go that? Alvaro: Because it was the most. Dr. Copley: You think this is the most, but it is shorter. Alvaro: I was right. Because you got a lot of water there and then it spilled.

Dr. Copley: Yeah, you were right. But this one is so short and this one is so tall. Why did you think this one would hold the most, because it did. But, this one's so short and this one is so tall. Isn't that funny? Did you think that was funny? [Video ends]

Dr. Copley: Did you hear the words the children used to describe the containers? Kira obviously looked at the attribute of height and believed that container held the most liquid. Alvaro noted how "fat" the other container was and predicted correctly. In both cases, the result seemed "funny" to both children because they did not understand what happened to the water as it was poured back and forth. It seemed as if the amount changed and it was not easily explainable. Both children were anxious to do more exploring.

The next day these plastic containers were added to the water table and investigated by everyone! Let me tell you one more story that illustrates the idea of conservation. Armando was doing a similar task with me. Like Kira, he focused

on the height of the container and predicted that the tall container would hold the most water. As I was pouring the water from the tall skinny container into the short fat one, he said, "It disappeared! The water is disappearing!"

Then, when I poured it from the short fat container back into the tall container, he breathed a sigh of relief and said, "Oh, it comes back." Armando's comments illustrate that he believes that the amount of water changed as it was poured back and forth between the containers. He will do much more experimenting before he develops the concept of volume conservation. As you can see, these young children responded using perceptual clues -- that is, what it looked like.

Their measurement ideas are based on perceptions, and then informed further by their experiences. You and I are not too different than they are. If we have not had many experiences with a particular measurement, we compare measurements using perceptual clues. Let me illustrate. In this picture you have three different tangram pieces. If you look at these pieces, and I ask you which one is larger -- if you are focused on the length of this one, you may believe this one is.

If you are focused on how wide this is one is here, you may say this one covers the most. In reality, these three pieces have exactly the same area, or, in other words, they cover exactly the same space. Let me illustrate this with another example. I have a container that you have seen before. It's a container holding three tennis balls. Now I want you to look at this and decide two things for me.

I want you to first of all look at the circumference of the container, whatever that distance would be or that length would be, and, I also want you to think of the height of this container, and I want you to decide which one you think would be the longest: the distance around, or the circumference, or the height of the container. Most people -- all the adults that I know, or many of the adults that I know -- would predict that the height would be the longest. Let me show you.

If I take this piece of orange paper and move it around the circumference, it is right here at this distance. If I hold this up here, you will see that the circumference is slightly larger or longer rather than the height of this container, so the circumference is actually greater than the height. Most of us used our perception of the height and we said that would be the longest. Again, if you haven't had that experience, you wouldn't be able to do that well. Let's do just one more to illustrate that point.

Let me illustrate this with this sample. I want to you think about snapping for just a few minutes and snapping -- by snapping, I mean this. You may be a one-handed snapper, or you may be a two-handed snapper -- and those would count as separate snaps -- or you may be a two-handed snapper that only gets one snap. Okay? Whatever your procedure, I want you not to snap right now. And without snapping, I want you to estimate the number of times that you can snap your fingers in one minute if you never got tired.

Now, no snapping going on, please. Please write down for yourself -- write down the amount of snaps that you think you'd get if you never got tired, in one minute. Okay. Did you write your estimates? I hope so, because now we're going to get a small sample of your snapping ability. I will time you for 10 seconds. You are going to see the timer on the screen. What I want you to do is snap as fast as you can, and count as you do it.

Then, when time is up, you're going to write down your number, multiply it by six since we only did it for ten seconds, and you will get a better estimate of how many snaps you can do. Are you ready? Go. As fast as you can. Stop. Write that number down. Multiply your number by six, and now compare your first estimate with this second one. Are they close? Probably not! In fact, if your response is like most people's, the numbers are very different and you underestimated what you could do!

Why would your estimation be so poor? You know what a snap is, and you know how long a minute is. And yet, you probably have never had the experience of snapping and measuring the amount of snaps in a particular time period. Do you see the connection to children's understanding? Children will use perceptual clues if they do not have many experiences with measuring, just as you did. Well, what do you do to help children develop conservation? Research indicates that we should provide many opportunities for measurement.

The water table should have containers of many different shapes and sizes. Clay should be measured in a variety of shapes. Children should have a number and variety of experiences with different sizes and shapes of materials. Measuring activities should not be restricted just because children do not have the concept of conservation. We know that children learn to conserve by participating in measuring activities and by reflecting on the results. Transitivity is a second measurement concept that is important to young children.

Stated mathematically, it means that a person understands that if a is greater than b, and b is greater than c, then a is greater than c. Or, that if c is the same as b, and b is the same as a, then c is the same as a. Or, that if c is less than b and b is less than a, then c is less than a. Well, what does that mean to young children? First, and most importantly, it means that when comparing two objects, children first understand direct comparisons before they understand comparisons to measurements on a measuring tool.

Let me give an example to illustrate this idea. Imagine that two young children are talking quite excitedly about how tall they are. They are trying to determine who is taller. If the two young children are to decide who is tallest, they would need to stand back-to-back and compare their heights directly.

If instead, you asked each of them to measure their height against a measuring tool like a measuring tape or a "teddy bear totem pole", they may be able to say that one student is three teddy bears tall and the other one is four teddy bears tall, but some children may not understand that the number helps them relate their two heights. In other words, they may not believe that the two children's heights can be compared just because they both relate to the teddy bear.

When introducing measurement to young children, direct comparisons should always be the first method used, and then the object's attributes should be related to specific measurements. Let me further illustrate the concept of transitivity with a video clip of a class balloon rocket experiment. You will note that this experiment is done in a separate room, for one good reason. When a balloon rocket is released in an early childhood classroom, everyone wants to be involved, and they are!

As you can see by this diagram, a long piece of string containing a straw is attached at two objects one is lower than the other. Then, a balloon of air is taped to the straw. Let's watch and listen as I blow five breaths of air into the rocket and it blasts off!

[Video begins] Dr. Copley: That's two. See,I'm not popping it. This is... Children: Three. Dr. Copley: That's three. Not popping it, right? Children: Four. Dr. Copley: That's four. I'm not going to pop it. I haven't ever popped it, ever.

Children: Five! Dr. Copley: That's all. Okay? Now I'm going to tape it. So taper, mechanic, come over here and help me get the tape. Okay. That's enough. Child: You didn't get enough, so there. Dr. Copley: Okay.

Child: Ewww, that sounds... Dr. Copley: One more piece, Nathan, and I'll get it because you gave me a... Brandon: Nooooo, you're going to pop it! Dr. Copley: It's not going to pop, It's not gonna pop..

Nathan: Brandon, just watch. Dr. Copley: Just watch, Brandon. You'll be fine. Do you want to go sit over there. Brandon: I'm not scared of anything, I'm not scared of anything!

Dr. Copley: Are you ready? We're going to count. Will you come over and hold right here? Just hold it down here with me, with my finger. Are you ready to look where it's going to go? Help me count. Ten, nine, eight, seven, six, five, four, three, two, one, blast off! Child: Oh! Dr. Copley: Look at it go! Give it a hand. We did great.

Child: It went farther than that. Dr. Copley: Here is our measurer. Ok, Mark, bring the paper over. Let's put it a little more like this. Put your hands up for a minute, put your hands up. There we go. Mariah, could you put a piece of paper here? Ok, Mark, you and Nathan come over here and see. Why don't you all stand over this way so you can kind of see it. Which one went the farthest?

Child: This one! Dr. Copley: This one and this one went far. That one is shorter. Which one is the shortest, though? That one right here. You guys, I am so proud of how you did! [Video ends]

Dr. Copley: Did you hear me emphasize that the balloon would not pop? One of the children in this group was quite concerned that it would. However, even after he was given the opportunity to move away from the experiment, he didn't do it. In fact, in the next trial, he was so excited that he held the balloon and wanted to continue even after his turn was up! Now, let's analyze this from the transitivity perspective.

Direct comparisons are always best for young children -- children who are typically developing the concept of transitivity. However, in this balloon rocket experiment, only one balloon can be launched at a time, so a direct comparison of the distance of two balloon rockets could not be made. Using a continuous stream of adding machine tape, we measured how far it went for each time it was released. Then, we compared the strips using direct comparisons of their length.

In other words, I was creating an experience that required children to use transitivity. They knew that one of the balloon rockets went the distance of one of the strips of paper and that another rocket went another distance as indicated by the paper strip. They then compared the distances traveled by the rockets, indirectly, by comparing the paper strips. So, what do you do to facilitate children's understanding of transitivity? You model it.

In the video clip we just watched, you saw the modeling that can occur for young children, and the discussion that can follow about their ideas. To help children develop transitivity, they should see many models and discuss both direct and indirect comparisons. The third measurement concept that pertains to young children is the idea of the unit. Remember the definition of measurement? It means, "assigning a number to a continuous quantity."

To assign that number, the quantity to be measured must eventually be broken up into equal-sized units. If a length is measured, the quantity might be broken up into non-standard measurements of popsicle sticks, plastic links, plastic teddy bears, or even yarn pieces. Or, the length might be broken up into standard measurements of inches, or feet, or meters. If capacity is measured, the quantity might be broken up into cups, containers, or scoops.

If weight is measured, the quantity might be broken up into counters or weights of some type, or even rocks. Simply stated, units of the same size and type should be used consistently and repeated for the measurement of one quantity or object. The diagram shown illustrates this idea by using a length measure. As you can see, the top diagram shows units that are the same size and type. The second group has the same type of units, but they are not the same size, and the third group has different units that measure different lengths.

Another important unit concept is that there is an inverse relationship between the measurement and the size of the unit. This is a concept that you have already learned. Let me explain. Let's pretend that we want to fill the large container in the middle of the picture with a liquid. If we were to use the small cup on the left of the picture, it would take about twenty cups to completely fill it.

If the large cup on the right of the picture were used to fill the large container in the middle, it would take about ten big cups to fill the container. So, it takes more little cups and fewer big cups to fill the container. That is what is meant by an inverse relationship.

Asking this young child, "How many cups of sand did it take to fill the tube?" would begin to help her understand the concept of "unit". Let me illustrate the idea of "unit" with an exploring activity that young children completed in centers over a period of a few days. Using a book written by Steve Jenkins, children measured their height using different size feet. Listen as I introduce this activity.

[Video begins] Dr. Copley: Today I brought lots of different feet. I brought the real size, my grandson's foot -- he's only one -- and I took one of his shoes and traced. That's his footprint. Isn't that funny? Children: Yeah. Dr. Copley: That's the actual size. He's very little. I put them up over there. Can you look over on the wall and see that yellow? In fact, today I want to know how tall you are if you use my grandson's baby feet. I wonder how tall I am in my feet? My feet are bigger. One, two, three, four, five, six.

Child: You've got six feet. Dr. Copley: I'm only as tall as six of my feet. I've got a lot more of the baby feet. Here is

the funny one. Are you ready? Children: Yes. Dr. Copley: Look at the book. [Children laughing] Whose foot do you think this is? Children: Elephant!

Dr. Copley: You are exactly right. It says, "This foot belongs to (it's a mammal, you're right!) the largest land animal, the african elephant." Guess what I did? This is so funny. You see this picture? You're going to be just amazed at this. Look. Child: I saw an elephant. Dr. Copley: Look what I did. I made one with elephant feet, too. How many feet tall am I in elephant feet? Child: All the way to the top.

Dr. Copley: I'm just one, two, three and a little bit more. Isn't that funny? Child: Yeah. Dr. Copley: I'm 15 of the baby feet and I think I was seven of my feet. Child: No, you weren't. You were six. Dr. Copley: And look at how many I am, I'm only three of the elephant feet. A little more than three.

Teacher: Ok? See how tall Daniela is? It's about her height. Let's count! Stand right there. Let's count how many feet of Daniela's are. Ready? Teacher and Children: One, two, three, four, five. Teacher: So she has five of her feet. So on Daniela, on her feet, we're going to put the number -- Children:Five!

Teacher: Five. Now let's see how many elephant feet, how tall Daniela is in elephant feet. So she comes about right here, so okay, scoot over! Child: I think three. Dr. Copley: Ready? One -- Children: Two.

Teacher: She's about two and barely on three. So do you think we need to just say two or do you think three? Because three is way up here. Children: Three. Teacher: Three? Let's see, Daniela...

Children: One, two, three. Teacher: Ok. We're going to say three, then. She's about halfway of the three. Ok? Three elephant feet. Let's see how many of Dr. Copley's feet she is. She's right there. Ok. Scoot over. Ready? Let's count. I want to hear everybody. Children: One, two, three, four. Teacher: She's four of Dr. Copley's feet. Wow! And how many baby feet do you think she's going to be?

Child: A lot. Teacher: A lot? Child: Yeah. Teacher: Like how many? Child: I don't know.

Teacher: Guess. You think twenty? Child: Yes. Teacher: How many do you think, Mark? Mark: Twenty. Teacher: Let's see. Ready? Okay, scoot over, Daniela. Ready? Let's count. One --

Children: Two, three, four, five, six, seven, eight, nine, ten... Teacher: Ten -- she's only half of twenty. She's only ten of baby feet. Wow! [Video ends]

Dr. Copley: These foot measuring strips were left in the class for several weeks and children used them to measure their height. Later, when I asked why the little baby feet had big numbers and the big elephant feet had small numbers, all of the four year-olds just shrugged and said, "They just did!" In another class, a similar experiment was constructed when a group of five-year-olds measured their height using two different-sized teddy bears -- totem pole.

The first day they used the larger teddy bears, and the second day they used the smaller one. Most of the 5-year-olds in this class described the difference as a growing phenomena. When asked why they had a bigger number on the second day, they said, "I just growed!" or "I ate my vegetables last night." or "My brother stretched me!" Only a few children said something about the bears being a different size. So, what do you do to facilitate children's interest and understanding of "unit"?

Provide examples using equal-sized, repeated units and show that there is an inverse relationship between the measurement and the size of the unit. Children need a variety of experiences that help them see the problems of measuring objects or quantities using unequal units. Our job is to provide varied measuring experiences for young children and encourage them to reflect on these experiences. This idea is best illustrated in another video clip.

In this video vlip, a mother and two children, ages three and five, are racing two cars down a ramp. To see which car travels the farthest, the children use rope measures that are different lengths -- and it is on purpose! Let's watch as the 5-year-old explains the problem.

[Video begins] Mother: Okay, Tess, let's go. Woo! Look where it went! All right. My turn. There it goes! Tess: One... Mother: One... Tess: two...

Mother: Uh huh. Tess: three... Mother: Yep! Tess: four.. Mother: Uh huh.

Tess: five. Mother: Good counting. Don't touch the car. Now we're going to measure my car, right? Tess: One, two, three, four, five, six, seven. Mother: Seven? You don't touch it yet. Let's see, is my car further away than your car?

Tess: No, but these are longer than the other one. Mother: It is? Are you kidding me? Tess: Uh-uh. Mothery: Your rope is longer than my rope? Whose is farther away?

Tess: Mine. Mother: Does that mean your car or my car? Tess: Mine. Mother: But whose number was bigger? Tess: Yours.

Mother: Why? Tess: Because we had the not same rope. Mother: Because your rope was what? Tess: Long. And yours was like a baby.

Mother: Like a baby rope. Hold them straight, though. Tess: These are different because yours is shorter and mine is longer. Mother: Yeah? Tess: And if we just take the same inch, it will be the same number and then we'll have the same space. [Video ends]

Dr. Copley: Don't you just love this example? This is a case where the five-year-old showed her development and her understanding of the inverse relationships, and the three-year-old just loved racing the cars. I also love the way the mother commented at each place, not telling the answer but simply saying that it was interesting and listening to the child's response. As you can see, the idea of unit, like conservation and transitivity, develops over time.

Our job is to facilitate many measuring experiences so children will begin to understand these important concepts. Researchers recommend that measurement experiences also include some specific skills. First, the particular property or attribute to be measured must be identified. There are many attributes. "How long?" would be length. How wide? The width. How heavy? The weight. How much does it cover? The area. How much around? The perimeter or circumference. And, how much does it hold? Capacity.

These are just some examples of questions that can be answered. All of us have probably asked children a question about one of these attributes and have had children respond with a description of a different attribute. For example, I remember asking a young four-year-old how old he was and he answered four pounds -- just a different label. I am glad he wasn't that small! Let me illustrate this idea by describing the results of a lesson that I taught to a group of four-year-olds.

Please know, the purpose of my lesson was not to teach children how to measure, but rather to ask them to experience and experiment with ways to measure. After children played with a set of measuring worms for many days, I gave them a problem. I held up my arm like this in this way and asked children to measure the length of their arm from their elbow to their third, tall finger. I traced the length like this and explained that I wanted them to remember what they did.

I asked them to draw a picture to show me how they measured their arms with the worms. Let me show you the results! Initially, most children held their arm up like I did and tried to place the worms directly on their arm as it was extended. The worms kept falling off! The young girl in this picture was the first one that told all of her friends it would be okay to measure their arm by laying it on the table. After several arguments occurred like, "Mrs. Copley said to measure it with your arm up.

It won't be right if you put it down!", most of the children put their arms on the table, realized that it was easier that way, and they began measuring. Do you see the idea of conservation here? Children thought that measurement might be different if the arm was measured up rather than down on the table! This child used the small, equal-sized worms in

this picture to measure the length.

However, her partner at the table wondered if the green worms were different than the blue ones! Note the way this child is measuring the drawing of his arm using the width of the worms as the measuring instrument. Do you see the different lengths that this child used to measure her hand? This is obviously a child just beginning to develop this idea. Rather than length, this child is measuring the perimeter of the drawing of his arm using different-sized units.

This child is measuring yet another property, area. He is covering the arm in the picture with worm, again, using all different unit sizes. This child needed to use the worms directly on his arm to measure. He did not believe that a paper representation would work! He asked his teacher to put the worms on his arm and described exactly how they should be placed. He described it as "sideways." Please note that I did not tell children how to measure. Rather, I gave them the problem and then observed their methods.

Then, we talked about our results, and I wondered why we all got so many different answers. We talked about all the methods used, and then displayed our papers so everyone could see. In later lessons, we decided to use a particular method to measure. For instance, we used Jose's use of all his small worms, or we used Armand's use of the big worms and we went around an object, or we decided to use Maria's middle-sized worms to cover the area of the object to be measured.

Observing the different strategies children use to measure can illustrate how well the child understands the concept of measurement. It can also help teachers plan for the next instructional steps, and to scaffold their learning. As we have stated before, and I realize many, many times during this webcast, children should experiment with a variety of measurement concepts before they are taught more formal methods.

Physical movement can be used to help children understand the attributes of objects. In addition, this can provide an excellent opportunity to promote healthy development through physical activity. Watch as we walk the circle using measurement terms of different attributes.

[Video begins] Dr. Copley: I want you to walk real with heavy, like you know how heavy you were? I want you to take heavy steps. One. Like I'm an elephant. One. More. Heavy steps. Ok. Stop. Now I want you to be like a mouse and take light steps. Heavy steps. Two, three, four. Now light steps. Now I want you to take long steps. Long steps. Long steps. Long steps.

Now I want you to take short steps. Short steps. Short steps. Now take fast steps. Now take slow steps. Heavy steps. Light steps. Long steps. Short steps. Tall steps. Short steps. Tall steps. Short steps. Give yourselves a hand! [Video ends]

Dr. Copley: As you can see, movement exercises can be a great time to stand tall or raise your arms high. Just using more specific measurement terms and connecting them to movements can help children understand measurement attributes. They also provide a great way to walk to lunch! A second skill that is essential to the development of measurement is comparing. Children need to make comparisons between two objects or quantities and later between three or more objects.

Naturally, there are many vocabulary words that need to be modeled as children make comparisons. As you can see from these words, the comparison term to be used is dependent on the attribute being measured. Children at this center are comparing the amount of water that can be held by these two containers. To do so, they fill the cup they believe holds the most water, and then pour the water from that cup into the one they believe has the smallest capacity.

They expect and hope that it will spill over and are quite excited when it does! In this next video clip you will see children comparing a variety of fruits using two different attributes, weight and circumference, or distance around.

Later, after children have completed their measurements, the fruit will be taken to the kitchen, cleaned, and used as part of a fruit salad for everyone to enjoy. Listen as children first use a pipe cleaner to measure around their head, and then around the fruit. Also pay particular attention to the teacher as he encourages the use of specific vocabulary to

discuss their results.

[Video begins] Teacher: Now I want you to try one more before we do the fruit. Put it around your head. See if it will go around your head. Will it? Does it go all the way around? Child: No. Teacher: No, it doesn't. Does yours go all the way around? Try it this way. See if it -- does it go around your head? It doesn't go around your head, does it? Child: It's too bigger.

Teacher: What's too big? Child: My head. Teacher: Great. Your head's too big. Child: It can go around your neck.

Teacher: It will go around your neck, but now I want you to measure the fruit. Oh wow, this one's really, really light. I'm going to give that to you so you don't strain yourself. That one is pretty light. Do you know what light means? What does light mean? What does light mean, Androv? What does light mean? No, "light" means it doesn't weigh much, so that one doesn't weigh much. Oh, my goodness. Oh, wow. This is very heavy. That means -- that means... Child: It's bigger.

Teacher: It is big. And it also means, how much does it weigh if it's heavy? [Children's responses, inaudible] That means it's bigger, that means it weighs a lot. See if it will go around, Androv. See if the pipe cleaner goes around it. Child: Yep. Teacher: It does? Okay. It goes around it, so we'll put it...

Child: Right here. Teacher: ...on this side. Terrific. Okay. Androv, does your pipe cleaner go around? Here, I'll hold it still and you put it around. Does it go around? Child: No. Teacher: Look, look at it. Look. Here. You hold that and I'll do this part. You hold the fruit. Does it go all the way around?

Child: Yes. Teacher: Look. It's touching, so that means it does go all the way around. So where will we put it? Child: Over there. Teacher: Okay. We'll put it on this side. Katie, did this one..? Look at this, guys, look at that. Hold it over there. I'll hold it over here. Does it go all the way around?

Child: No. Teacher: It doesn't go all the way around. You want to try it with that? Let's see. Does it go all the way around? Child: No. Teacher: No, it doesn't. Go ahead and try yours. Is it going all the way around? Child: No.

Teacher: No, it's not. So where will we put this one? We'll put it over here. It's big. And this one is also kind of heavy, it's big. Do you think it will float or sink? Child: Float. Teacher: Float. Androv, what do you think? Will the pear sink or will it float? Androv: It will swim.

Teacher: Sink or float? Will it go to the bottom and sink or will it stay on top and float? Child: Um, get up and then they would swim. Teacher: So would you say it floats, it will stay up, or will it go all the way down? Child: Float. Teacher: It'll float, it'll stay on top? Ok. Katie, do you think this one will sink or float?

Katie: Sink. Teacher: Sink? You think it will sink, it will go to the bottom and sink? Let's try it, put it in. Katie: It goes up. Teacher: Wow. What is it doing? Children: It's doing nothing, going... hanging.

Teacher: Okay, but did it sink to the bottom or is it floating? Child: Floating. Teacher: It is floating. Let's check Androv's now, he's got the watermelon. How is the weight of it? Light or heavy? Child: Big.

Teacher: It's big and it's -- Child: Heavy. Teacher: Heavy, or is it light? Child: Maybe it's heavy.

Teacher: It's heavy. Now, do you think it's going to float or sink? I'm going to... Do you think it's going to sink to the bottom or will it float on top? Child: No, well, maybe. Teacher: I asked you do you think it will sink to the bottom or float on the top? Children: Float. br/>

Teacher: What did you say, Androv? Androv: Float. Teacher: It'll float. Katie, do you think it will float? What do you think it's going to do? Katie: Float. Teacher: Float? I think it's going to sink because it's so heavy. Will you put it in and try? Wow!

Child: We were right. Teacher: Well, I was wrong, but all three of you are right. It is... what is it doing? Child: Swimming. Teacher: Floating. It's floating. Katie, wow, that's pretty heavy. Do you think it's going to sink or float? Katie: Sink.

Teacher: You think it will sink? I think it's gonna too. Wait a minute, let's ask the other people. You think it'll float? Androv, do you think it sinks or floats? Child: Maybe it will swim. Teacher: Well, you know, to swim it really kind of needs arms and legs, right? So will it sink or will it float? Child: Float.

Teacher: It'll float? It'll stay on top and float? Let's check. Child:Sink. Teacher: Let's check. Put it in. Wow. It does float. So if it stayed up... so when it stays on top of the water, what is that called? Child: Floating. Teacher: It's called floating. And the grape -- what is the grape doing? [Video ends]

Dr. Copley: It's so much fun to experiment with measurement ideas. Let me tell you a quick story. I was in a Head Start site probably two or three years ago where and the teacher was doing, they were doing floating and sinking experiences and the teacher said with the children, "Well, the heavy things seem to go down and they seem to sink?" and a little boy said very distinctly, "My daddy's on a big boat and it doesn't go down."

And I thought, "Yes, the idea of heavy and light are very difficult concepts, especially when you talk about floating and sinking." Very, very interesting. Children love to experiment with it and I think it's one of the neatest things that you can do with measurement, especially if you're talking about heavy and light. Well, let's review.

What is measurement? For young children, it involves three concepts: conservation, transitivity, and unit, and, many experiences: identifying the attributes to be measured, comparing, and measuring a variety of objects. It's now time for a break. We will be back in a few minutes to find out how we can best facilitate children's learning of measurement.

Welcome back! Part two of this webcast outlines how we can best facilitate children's understanding of measurement. As in previous webcasts, there are three questions that we will answer. What should children learn? Where do they learn it? And how does the teacher intentionally plan for that learning? As you saw in each of the previous webcasts, the Head Start Child Outcomes Framework are consistent with the National Council Teachers of Mathematics Prekindergarten Focal Points.

The Head Start Child Outcomes Framework focuses on the developmental aspect of measurement by stating progress as an important aspect. They also suggest that it is important to measure different attributes by stating length and area of objects. NCTM talks about the importance of identifying measurable attributes, which again, corresponds to the Outcomes Framework.

Comparing on a single attribute is an important part of the Head Start Child Outcomes Framework and direct comparisons of objects on the basis of those attributes are discussed by NCTM as well. Please note that as they have been in each webcast, the approaches to learning are listed for measurement. Solving problems and applying reasoning is always an important outcome in mathematics. The active exploration in many of the experiences already discussed certainly reflects elements in measurement.

Finally, the language and literacy domain relates to measurement. Children need to communicate and represent their ideas using an increasingly complex and varied vocabulary, as well as using symbols to represent things. These skills are important to the interactions necessary to learn mathematics. And as you have seen, specifically in measurement! We have seen what children are supposed to learn about measurement. Now, where do children learn measurement skills? The answer to this question is always, "Everywhere!"

For example, in students' journals. This picture drawn by a five-year-old shows his response to a question posed in a news article. The circus was coming to town and children on the third floor of the hospital wanted to see the new baby elephant. This child showed his method of moving the elephant to the third floor of the hospital using a rather ingenious pulley! When asked why this elephant was on the ground and the child was up in the air, this child responded, "The elephant's bigger, of course!"

This child is doing his own conservation experiment deciding which clay ball is more. This restaurant play center provides the perfect opportunity to compare the sizes of cups. A small manipulative center allows children to explore number as well as height. This child builds towers on his peg board. Magnifiers in the science center provide opportunities to see size differences. It does look bigger when you use the magnifier.

Books that emphasize animal measurements like Steve Jenkins' "Biggest, Strongest, Fastest" are always exciting in early childhood classrooms. Published in 1995 by Scholastic, this book uses terms children can understand and provides additional information for class explorations. For example, when children found out the length of the blue whale, we marked it off on the outside playground and children spent lots of time running across it!

The blue whale's length of 110 feet provided lots of exercise for us! Children constructed their snowmen so that the big circle was the head, the bigger circle was the middle, and the biggest circle was the bottom. The floor of the cafetorium provided a perfect place to put our rocket measurers so we could continue to compare how far they went. Cooking at home or at school always provides opportunities for measuring.

Not only is it an enjoyable measuring experience, it also facilitates communication between caregiver and child. Now, how does the teacher intentionally plan for learning measurement? As in the first three webcasts, we will discuss how the teacher plans experiences and the importance of mathematizing language. As we mentioned at the beginning of this webcast, children love to measure themselves and compare their measurements to others.

Children in this prekindergarten class each made a sand baby that had the same weight and length as they were when they were born. Let me show you the one I made. The baby is made out of a bag of sand and the children weighed the sand to make sure that it was the same weight as their birth weight. It is covered. It's in a plastic bag and taped so that the sand doesn't spill out and then it's covered by a cloth napkin. Children got to choose their own color. Then they made their own faces.

This particular face was made after great consultation. The children all had to go talk to their mothers, their families, and find out if they had hair, what size their eyes were, what their nose was like. It became a wonderful opportunity to explain -- for children to talk to their families. It became a whole family experience. As you can see, this type of experience needed to be intentionally planned. First, birth weights and lengths needed to be identified.

Second, the necessary materials needed to be purchased. Third, each child needed to have an opportunity to measure his own baby's weight and length. And finally, most importantly, children's understanding of weight and length needed to be scaffolded. Lets watch as children make and actually hold their sand baby, a baby that weighs what they did when they were born.

[Video begins] Dr. Copley: Not taller, just... heavier. Heavier. Okay, let's pick it up. Let's pick it up, Oliver. This is you. This is you as a baby. Okay. You know what? We need just a little more. Pick it up. Pick it up. All right, could you put in one more cup for me? I think we'll be right. See if you can get a big cup in there. Whoa. Oh, man. Oh, put in one more. Let's put in one more just for kicks. Shake it a little bit more. There you go. All righty. Okay.

Are you ready? Can you pick it up again with me? Oh, man. Okay! That works, that works. Take it over to Miss Wilson. She's going to help you. Now be careful. Don't drop it on the way over there. There's your card.

Miss Wilson: How many pounds are you? What's that number? Child: um -- Miss Wilson: Six? Child: Six.

Miss Wilson: Six! Do you think you were a big baby? Child: Yeah. Miss Wilson: Do you think you're the biggest baby in here?

Child: Uh-huh. Miss Wilson: Who do you think is going to be the littlest baby in here? Child: Me. Miss Wilson: Do you think you were heavy? Child: Mmmm-hmm!

Miss Wilson: Yeah? Child: I was big and heavy. Miss Wilson: Big and heavy. Child: That's why my mom carried me and says I was big. My grandmother said I was...

Miss Wilson: You want to hold yourself? Child: uh-huh. Miss Wilson: Hold your hands out like you're going to hold a baby. Ok. Now let's see how tall you are. You see that number right there? It says 19. Can you say that? Nineteen. Nineteen inches. That's how tall you were.

See? See that's how tall you were. Do you think you're taller than that now? Huh? Ok. We're going to put this right here, save it for next week. And you can hand me your baby. Thank you. You are done. [Video ends]

Dr. Copley: I wish I could capture for you the excitement in our class as children held their babies for the first time. They were so careful and reluctant to let anyone else hold them! Indeed, they were their babies! Kira said that her baby was really light! Mariah said, "My baby needs to be held close," and she did. Jacob needed his baby to be carefully wrapped so he didn't fall out! He knew that was important. Tiffany said her baby was just beautiful!

Katie said her baby was really too heavy for her to carry, but she did anyway. Desiree did not want to put hers down and in fact, she carried her baby around with her for most of the day.

After we had individual experiences with our babies, I introduced the photographic book by Margaret Miller entitled, "Now I'm Big." Listen as I introduce the book to the children, continue to mathematize their language, and help them as they write their own pages for their class book entitled "When I Was a Baby and Now I'm Big."

[Video begins] Dr. Copley: ...which says "now I'm big." When you made your babies, you were really funny because you said -- when you made your babies and we weighed them. Remember I had you weigh yourselves first on the scale, and you were a big number of pounds. Most of you weighed 30 or 40 or 50 pounds.

Child: Forty. Dr. Copley: Yes. There were a lot of people that were about 40 pounds. When you made your babies, you were only five or six or seven or eight or nine pounds. Child: Different.

Dr. Copley: Yes, everybody had a different pound. And when you made your babies, you all said, "Oh my!" Remember we kept pouring sand in? But if I would have had to pour enough sand in the bag for how heavy you are now, I didn't have a bag big enough. Did you see me... did anybody see me carry that great big bag of sand that had 50 pounds in it? Did you see me dump that in there? I could hardly pick it up. I was just, "Ooohhh." So I'm not going to pick you up, am I? No way am I gonna pick you up.

Dr. You are heavier than your baby, than when you were born, right, Mark? Yeah, you sure are. Child: When we were born, you could pick us up. Dr. Copley: Yeah, I know. When you were born, I could have picked you up. But now you're too heavy, right? Children: Yes. [children talking]

Dr. Copley: Okay, all of you share, that's good. [Children talking] Okay, good, now can we say when I was a baby I was short? And now you're tall. Is that okay? When I was a baby, I was -- look how much you've grown! Look it! You're almost too high now. [Video ends]

Dr. Copley: We had so much fun making our books and writing about what our life was like as a baby versus what our life was like as a big four-year-old. In this picture, Isaiah and Dante were comparing their babies using their own language. They discussed all about their hair and the covering they used and they even talked a little bit about how much they drank when they were hungry. When we were doing -- writing our books, in this next picture, you're going to see that the babies needed to be next to us.

In fact, those babies stayed with us -- next to us -- even when we went to lunchtime. If you look at the next picture, you're going to see that, while we were making our books, it was also very important that we talked to each other and talked about our babies. I only wish I could share all of the conversations that happened because of these babies. In the next picture, you're going to see that the children drew some beautiful drawings and they provided representations of their ideas.

One picture I especially remember was a picture that was drawn because this baby was very, very heavy and the child

drew it very, very big just to show that. It was really interesting. Well, I will tell you that the sand babies activity was one that really made a difference in our class, not just for measurement concepts, but also in the social-emotional development of these young children. They talked to their families. Those babies were important to them. And I even like that. I like math.

But I love it when other things can occur as well. Well, we are now ready for the third part of the session, "What else? " Remember, this is your opportunity to respond to my questions or to ask your own. Please consider submitting your questions by email or fax as indicated on your screen. It's your turn. What questions do you have for us? Back again to help with today's Q and A session is Amanda Bryans. Amanda?

Amanda: Thank you, Juanita. It is not too late to send your question in. Remember you can type the question into the "ask a question" form on the browser. Or you can fax us your question. Our fax number is also posted on your browser.

Now, we have our first question for this afternoon. This is from Laquesia in North Carolina. She asks, "According to the Piaget's cognitive stages of development, children ages two to seven years are considered to be in the preoperational phase. What age is too early to begin introducing the concept of conservation given Piaget's thinking about developmental stages?"

Dr. Copley: Very good question. And you are right, according to Piaget's theory, children are in a preoperational stage. I think the idea of introducing children to a concept is something that I'm not in charge of. The fact is that, as they experience and do experiences with measurement, they're constantly introduced to the idea of conservation.

So I just simply present activities and make sure that is facilitated, their understanding is facilitated. Just because children are not -- do not have conservation doesn't mean that they're not going to benefit from as many measurement experiences as possible and they'll development conservation in their time.

Amanda: What I was really impressed with in the video clips was how joyful the children were as they were engaging in the experiences. And they were all in different places. Kids were expressing different kinds of understandings of the various concepts. Similar to my daughter, what seemed important was that they do things over and over, again, you've talked about that a lot. Children need to be able to experiment and do it until they are able to build and expand and go to the next level.

Dr. Copley: Yeah and I even think of the, if you remember, the floating and sinking incident. The children used the pipe cleaners that they had already seen were exactly the same size, but they all wanted to put that around that melon to make sure that it was the same for each of those. Amanda: All the different cleaners, even though they'd compared the cleaners to each other, they still couldn't do that...

Dr. Copley: Yeah. I think it's just something that children continually do and my job is not to say now it's time to develop the concept of conservation, but it's simply just to let them have as many experiences as possible. And I will say that I've seen children develop that idea of conservation at many different ages and at many different levels.

Amanda: So what's important is that each child is experiencing success as they are experimenting at the level that they're in. Dr. Copley: Right. Amanda: That there isn't an arbitrary time where you say, "Okay guys, you all have to get this now and if you don't, you're not --"

Dr. Copley: Right. Amanda: Great, great question. Thanks for sending that in. Keep those questions coming. This is from Renï¿½e in Missouri, "In the video segments you use a lot of unique measuring tools, such as faces, adding machine tape, pipe cleaners and worms, which will probably be famous for ever more. Should you also use standard measuring tools? Should you have things like rulers available for children?

Dr. Copley: Yes. I really love this question because one of the things that bothers me about some of the video clips, we didn't get in all the different measuring tools in our room. I firmly believe that children need to see all types of measuring tapes: measuring tapes, measuring instruments, scales. For instance, the scales the children were using to

measure the sand babies on, that stayed in the room and children were always running over and getting on the scale and watching the numbers go up.

They may not know what it meant but they loved to use that. Measuring tapes are used, rulers are used. Again, my goal is not to teach how to use rulers but simply for them to use them and see them used and to see the teacher use them in an appropriate way. So every...I don't consider some tools not okay for children to have. I just believe they should experiment with all things.

Amanda Bryans: It's important that they're getting the idea of same and different units, right? Dr. Copley: Sure. Amanda: So the variation is good in that you can get kids the idea of things that are the same unit and multiple items. But clearly rulers are terrific tools. They're easier sometimes. They're rigid.

Dr. Copley: That's true. I have experiences with children who I've taken -- they have rulers and they've been measuring how far it is across the room and they hold the ruler and walk across the room counting their steps. Again, just an experience with measuring. And the more they see, the more they try, the better it is to be able to scaffold that learning.

Amanda: Great. Thank you for that clarification. This is a question from Robert in Wisconsin. Robert asks, "At what age should you introduce real rather than comparative measurement units to children?"

Dr. Copley: If you remember, I think I'm interpreting this question correctly. Comparative, when you're comparing whether this is heavier or this is lighter, or is this longer or is this shorter, that really is almost the second step that you do. The first step is talking about the attributes. The next stage is comparing.

Later on, after they get the idea of unit, then you start counting those units. And that's -- counting the footprints, for instance, was really a precursor then using actual measurements and standard measurements. So, again, it's watching the child, knowing where they are -- comparing questions I think are always very appropriate, and then you start counting units, which is obviously when you're talking about real measurements.

Amanda: Great. That's a real testimony to the art involved in early childhood teaching in that we're expecting teachers to individualize and make appropriate developmental experiences available for each child and having the full range. Dr. Copley: And really measurement is one of the easiest ones to do that with because kids are so interested, number one, and yet there's just so many different levels.

Amanda: This question comes from Shannon in Louisiana. She asks, usually measurement is taught after children have a foundation in numbers. If the children in my center don't yet really know their numbers, should we still be addressing measurements?

Dr. Copley: That is really an excellent question as well because, as you saw when we were counting the feet, you had to count the feet to do that. So one of the things I would say in this, to answer this question is, you can always count something and some children are not going to have that number concept.

But I would constantly be talking about comparing in measurement, over and over and over again, and then count when you have a chance. But they don't have -- you don't ignore measurement until they get number. That's silly, because they are going to be comparing all the time anyway. Amanda: In fact, measurement may really help them solidify what they're learning about numbers.

Dr. Copley: Numbers are important, and there's so many concepts even in geometry that deal with measurement. So I'm not a believer, if you can't tell already, I'm not a believer that you do this thing first and then this thing second and this thing third. I just believe in giving kids as many of those experiences as I possibly can.

Amanda: Terrific. This is from Marcus in California. "When you're observing children making errors when measuring, how do you know when to intervene?" We've talked a lot about kind of giving children the chance to experiment and experience and not leading them too much. How do you know when, if they're on a wrong path, then you need to help

bring them back into the measurement fold?

Dr. Copley: You know, Marcus, I wish I could answer this question perfectly right. I think this is the real skill in teaching, especially with young children -- knowing when to ask the right question, knowing when to ask a question that helps them identify their error or whether you really teach them something at that moment. If you remember the gentleman on the tape with the little boy who did not believe that went all the way around, he asked to help them.

Another little boy said, "No, it was definitely around", and he still wasn't quite sure. Then he gave a further definition. And the little boy then took that. He was actually using that moment to teach and to do that directly. He did not tell him that, but he just constantly kept asking. In other cases, I set up an experience to let them see.

If you remember the mother with the two cars racing down, she didn't say to the little girl who was three, come on over here, make sure you get this, you need to know that the long one is different than the short one. She wasn't ready for that. But the five-year-old was definitely ready and she kept asking questions until she clarified it. So it's the skill of teaching and sometimes I do it correctly and sometimes I don't.

Amanda: It looks like you get it right frequently. Dr. Copley: Well, I try.

Amanda: This is going to be our last question, unfortunately. We're running out of time. But I think it's a good one to end on. Should you normally spread your measurement activities throughout the year or do you cover them kind of as a unit at one time during the year? And kind of along with that, do you see doing these measurement experiences as a separate, distinct part of the daily routine or is this something that can be integrated throughout children's day?

Dr. Copley: This is a question that I love to answer because it really focuses in on what I believe about early childhood education. So many people at the elementary school level, at the primary grades, whatever, do things in units and distinct differences. Early childhood is an area where I just think we have it right. We do things integrated, we do them throughout the entire day, and that to me makes a difference.

Measurement is not something you wait until the end, until they get all their numbers or whatever, but instead you have measurement experiences all the time. Children are interested in this. And they love it and they want to know how big they are, how small they are, whatever the case may be. It's just something that you integrate throughout all of the day. You have measurement stuff out everywhere. You model. You do it when they're interested in the question.

Amanda: That sort of really supports some of the other things you've said about meeting different developmental needs of children. If you were to reserve that for just one time of the day or one time of the year, it really wouldn't match the needs of the emerging development and needs of the children. That's terrific. Thank you, Juanita, and thanks to all of you for your thoughtful questions. Now, lets recap what we have discussed related to measurement.

In part one, we talked about both the concepts of measurement and the experiences that are important to understanding measurement. In part two we observed many different methods for facilitating the learning of measurement. Then, we began to discover what else we could learn in part three. This concludes the fourth of six webcasts emphasizing mathematics in Head Start and other prekindergarten settings. Our next webcast will be about patterns on March 13th.

Our final webcast will be on April 17th. We will be putting it all together. Some questions you may want to think about before the next session are: what vocabulary did you hear used during this session? What materials would facilitate learning about measurement? How intentional are your teachers about teaching measurement? What one big thing could you do tomorrow to help teachers facilitate the learning of measurement? We look forward to being with you again in March as we address patterns for young children.

Please visit the Head Start ECLKC for additional information concerning measurement. In particular, an article is posted that was published in the National Council for Teachers of Mathematics NCTM journal about measurement experiences for young children. I know you will recognize some of our activities in this webcast as you read it! As I hope you know, the ideas in the webcast are created from a large variety of resources.

Published research, personal experiences, and examples from a variety of preschools and home centers. Some of these resources are listed on the ECLKC. Please take time to review them. They will tell you much more than we can possibly show you in this short time. Also, please feel free to send any successes or stories of your work implementing mathematics or suggestions that you might have about these webcasts by faxing us or sending an email to the address at the bottom of the screen. We would really like to hear from you.

Once again and most of all, thank you for taking the time to be with us today for the fourth webcast in our six-part series on early childhood math. Thank you for the time you take to make a difference in the lives of the children and families we serve every single day. See you next time.
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-- Premalink for viewing (requires Flash and javascript)

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